MINIMIZING CLAIMS IN DESIGN AND BUILD FLOOD MITIGATION PROJECTS

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Name of supervisor: Dr (Mrs) Sachie Gunatilake

Signature of supervisor: Date:

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ABSTRACT

Minimizing Claims in Design and Build Flood Mitigation Projects

The intensity and frequency of extreme weather events has caused severe damage to property as well as lives all over the world. Sri Lanka, no exception is one of major victim of such extreme weather conditions including heavy floods. Flooding remains as a danger mainly to unplanned and low-lying areas in the country. Kelani River, one of the main river basins in Sri Lanka, flows through centre of Colombo city. Being the capitol city of the country and experiencing continuous flooding, the government recently has taken measures to minimize damages to both properties and lives of people in Colombo city limits, by intensifying flood mitigation actions. Metro Colombo urban development project (MCUDP) was thus formulated to implement measures focused on reducing floods in Colombo city limits. Several projects were initiated under MCUDP focusing on drainage management and flood mitigation with an investment of USD 213 million from World Bank (WB).

These projects are being implemented as design-bid-build procurements. When the project is becoming more complex and need integral knowledge of experts with the need of fast track implementation, it becomes an inherent choice to follow design & build procurements where the contractor becomes responsible to both design and construction scopes. The research focus is on two projects focused on flood mitigation and being implemented as design and build procurement. By implementing projects as design and build procurement both funding agency and implementing authority expect several advantages over traditional design-bid-build procurement. Since single point of responsibility acts both in design and construction stages it is expected to see fast track implementation. In addition, the consultant knowledge and experience of experts are expected to in filter to project supervision.

When projects are implemented under donor funding agencies the project implementation authority is inherently bounded to follow guidelines set by the donor. Thus, these projects are following the procurement guidelines set by the funding agency. By implementing set procurement guidelines and methods it is expected to finish these projects with high price certainty and achieving strict completion targets. This give the opportunity to the funding agencies to disburse funding on new projects. Yet, it is observed a reasonable number of claims were raised by the contractor resulting to huge concern on achieving set delivery and cost targets. The research focuses on identifying sources for such claims and propose methods to mitigate such claimable situations. For achieving this objective, previous studies on sources for claims done by various authors were extensively studied and checked applicability to the existing project.

The concern of the research is focused on pre-contract stage of the project where the client has the most control. Thus, it is expected to come up with certain suggestions to minimize claimable situations applicable on donor funded flood mitigation projects, when the project is mostly under the client's control, i.e., at pre-contract stage. The outcome of the research is to be identified as a huge asset when implementing such design and build projects focused on flood mitigation funded by various funding agencies.

Key words: Floods, Funding Agencies, Claim, Design and Build, Pre-Contract, Sri Lanka

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LIST OF ABBREVIATIONS

BOQ	-	Bill of quantity
CEB	-	Ceylon Electricity Board
CRIP	-	Climate Resilience multiphase approach project
EPC	-	Engineering Procurement Construction
FEED	-	Front End Engineering Design
FIDIC	-	International federation of consulting engineers
GC	-	General conditions in the contract
GDP	-	Gross domestic production
ICB	-	International competitive bidding
IMF	-	International Monitory Fund
IFC	-	International Finance Corporation
KPMG	-	Klynveld Peat Marwick Goerdeler
LECO	-	Lanka Electricity Company
MCUDP	-	Metro Colombo Urban Development Project
PC	-	Particular conditions in the contract
QS	-	Quantity surveyor
RICS	-	Royal Institution of Chartered Surveyors
RII	-	Relative important index
SBD	-	Standard Bidding Document
UK	-	United Kingdom
UNDP	-	United Nations Development Programme
US	-	United State
WB	-	World Bank

1.0 INTRODUCTION

1.1 Background

Sri Lanka has two distinct monsoon seasons and experiences seasonal flooding due to extreme rainfalls. Flooding remains as a clear and present danger across many parts of the country. United Nations Office for Disaster Risk Reduction (As cited in Eckstein Hutfils, & Winges, 2019) observe "Sri Lanka was among the three most affected countries in the 2017 estimate in terms of weather-related loss events, ranking second highest on the Climate Risk Index which measures fatalities and economic losses occurring as a result of extreme weather". The flooding occurs in Colombo city limits has resulted to extreme disaster both for lives and wealth of the country. With climate change impact the flooding has become a frequent occurrent disaster. As cited by Silva, Weerakoon, Herath, Ratnayake & Mahanama (2012):

> According to the Disaster Management Centre (DMC), more than 38,000 families living in flood plains of Kelani River were affected during the 2008 flood, while more than 78,000 families were affected during the 2010 flood Moreover, Irrigation Department records show that there were two consecutive severe floods which occurred during the year 2008.

The disasters caused by flooding is in an increasing trend. United Nations Office for Disaster Risk Reduction observe:

> 2017 flooding following a strong monsoon, contribute to the risk status, as the event caused more than 200 fatalities and displaced more than 600,000 people across 12 districts Economic losses following the 2017 flooding increased by 50% when compared to the previous decade between 2007 and 2016.

Due to the ever-increasing damages caused by flooding, the government of Sri Lanka has initiated a number of long-term measures to minimize damages due to flooding. To achieve this objective, the government seeks concessionary loans from various funding agencies to cover up the required huge capital investment. After the devastating flood in Metropolitan Colombo area in 2010, Metro Colombo Urban Development Project (MCUDP) supported by World Bank has been implemented. As the second phase of the flood mitigation action plan Climate Resilient improvement project (CRIP) was initiated in 2016. Both these projects are funded by World Bank.

Yet when a funding agency was selected the borrower naturally need to abide with set guidelines set by the agency. As per the guideline set by the World Bank, the freedom to select the most appropriate method for the specific procurement system rests with borrower. Yet, bank drives borrower to use procurement guidelines set by bank when implementing complex projects. As stated in World Bank guideline (2004),

> "In certain cases, the Bank may accept or require a turnkey contract under which the design and engineering, the supply and installation of equipment, and the construction of a complete facility or works are provided under one contract."

This shows donor agencies' influence in selecting procurement strategy.

When implementing donor funded projects, the borrower is abided to complete the project in a set budget within the set delivery targets. It is observed a reasonable number of claims were raised while implementing these projects. Such avoiding possible claims by the borrower while implementing such projects is a challenge. Kavaleff (2004) observe causes for variations and claims in a contract is due to number of reasons namely poor planning, design errors, technical innovations, emerging new products, change plan by employer etc. and he finds contracting parties should address change control issues upfront in the negotiation process. He further states:

> On one hand, there are contractors who see an opportunity in changes. Charging for changes may improve results from the project. Employers should be aware of this when negotiating contract and change clauses. On the other hand, there are employers who take uttermost restrictive view on changes and who will reserve the right to say the final word on proposed change. (p 1)

Claims associated with cost and time overrun similar to the research in focus has led to serious concern to the project owner as well as the funding agency. Each party should identify areas that can control and minimize claimable situations upfront.
Charrett (2018) demonstrates:

> Financiers' perspective, the contract price needs to be fixed to the maximum extent possible at the time of execution of the contract, and this may involve the contractor in accepting risks that in other contracts are born by the principal (p.430)

Chan and Kumaraswamy (1997) divide construction process into three phases, i.e. project conception, project design and project construction and find:

> Project conception is the recognition of a need which can be satisfied by a physical structure. The project design phase translates the primary concept into an expression of a spatial form which will satisfy the owner's requirements in an optimum and economic manner. The construction phase creates the physical form which satisfies the conception, and which permits the realization of the design.

Royal Institution of Chartered Surveyors (RICS), 2011 identify the pre-contract period as the phase before the building contract has been entered into by the employer. Further identify this is the phase when activities such as the selection of the method of procurement, calculation of liquidated damages and deciding on the type of building contract take place.

1.2 Research Problem

There are a number of researches done on construction claims. Similarly, various studies were done by to prioritize and rank contributing factors for claims in past.

Flooding in highly urbanized areas is a new topic resulted from various manmade issues such as climate change and high urbanization. Research focus on first flood mitigation projects implemented in Sri Lanka. Such studying construction claims and proposing measures to minimize claims on projects focused on flooding in Sri Lanka, is a new topic which was not in discussion.

Measure to minimize construction claims and associated cost and time overrun is becoming an important new topic with implementation of these projects. Since these projects need high initial investment government agencies need to directly involve in these projects.

The research is an effort to “investigate how to minimize claims in design and build flood mitigation projects in Sri Lanka at the pre-contract phase”.

1.3 Aim

The research aim is to Investigate claims raised in the pre-contract stage of design and build flood mitigation projects being implemented in Sri Lanka. It is expected to identify causes for claims and propose measures to minimize claims at the pre-contract stage, i.e., when the project is under client's control.

1.4 Objectives

- To review causes for construction claims
- To identify most relevant causes of claims applicable to pre-contract stage of design and build flood mitigation project in Sri Lanka
- To propose measures to minimize/avoid claims in future design and build flood mitigation construction projects in Sri Lanka

1.5 Methodology

1.5.1 Literature review

Several researches and studies have focused on studying construction claims. They have identified ways and means claims were linked toward variations, disputes. Focus of all these studies are to achieve the common objective, i.e to identify and suggest means to avoid/minimize claims. Principally, claims emerge all over the world in global construction industry. The causes identified by review of literature were tabulated and presented. The identified individual causes were initially, grouped under six main categories applicable to the research and was identified as major causes for claims.

1.5.2 Questionnaire survey

Through the literature review, 59 causes of claims were identified which provide the basis for the formulation of the questionnaire to distribute. The identified causes were tested by 03 experts to determine the relevance to the research subject, i.e., on design and build projects focused on flood mitigation and funded by funding agencies. Thus, causes for claims were minimized to 39. The responses given to each source of claim

in the questionnaire were tabulated and ranked by RII method. This each scored RII value in the relevant group was averaged to identify the major causes for claims.

1.5.3 Expert survey

The most important outcome of the research is the opinion given by experts based on their experience suggesting means to avoid such claimable situation. An open discussion with these experts with storytelling approach is used to collect this information. The meeting outcome was related to causes of claims previously identified in the questionnaire survey. Thus, the expert opinions could relate toward identified 39 causes of claims used in the questionnaire survey. Meantime, expert opinion to minimize such claims were listed as recommendations to minimize claims in future such projects.

1.6 Chapter breakdown

The chapters were developed as illustrated below.

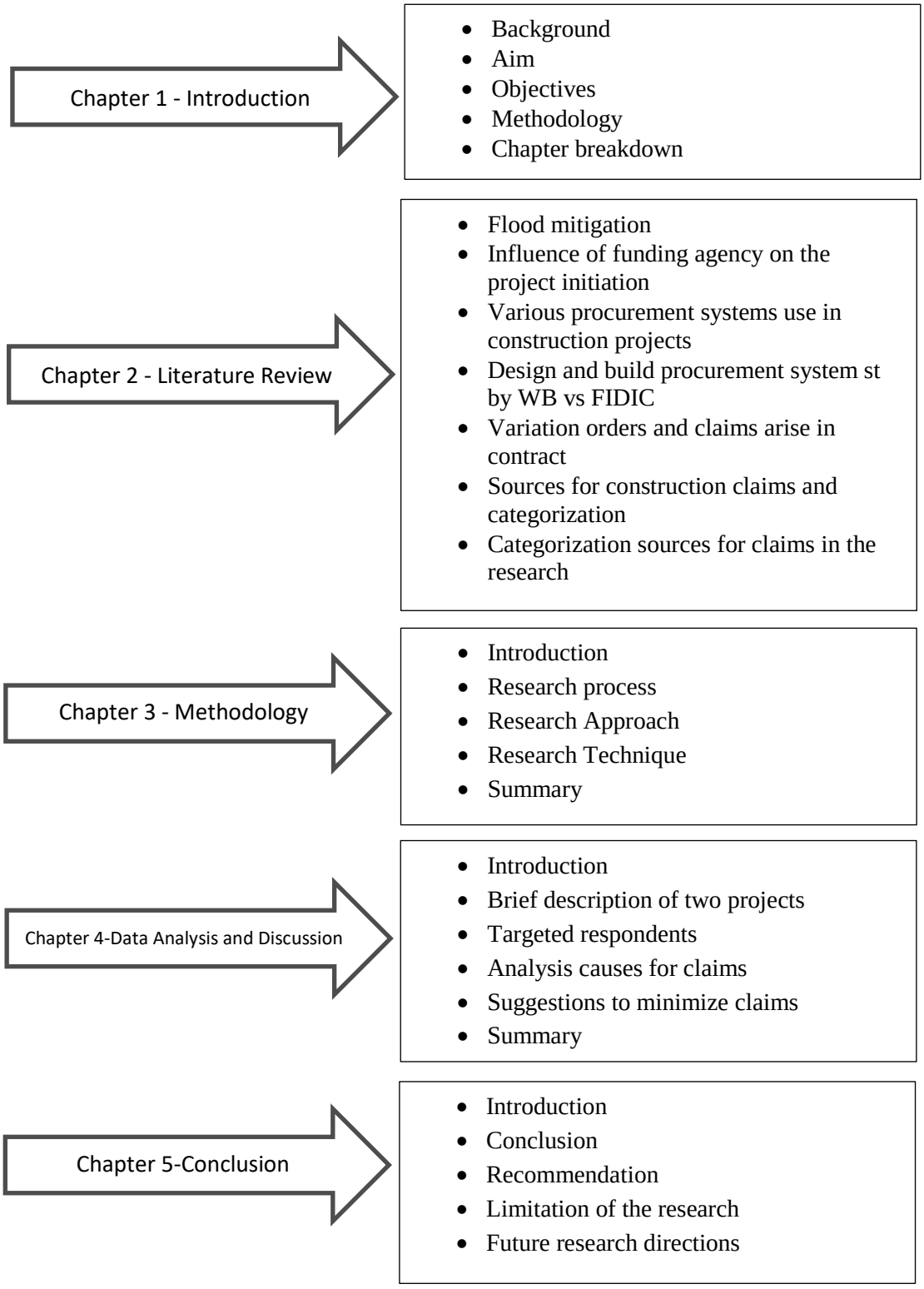

Figure 1.1: Chapter Breakdown

2. LITERATURE REVIEW

2.1 Introduction

This chapter focus on previous studies done by various researchers on flood mitigation projects. Conditions impose by funding agencies are also discussed. The research work limit to designed and build procurements. Such various procurement systems and any benefits, if any, by implementing design and build procurement will also be discussed. As discussed previously funding agencies request to follow conditions set by these agencies. Such it is important do a compare way these conditions deviate from standard conditions set by certain regulation authorities such as such as FIDIC. Finally, research focus on claims and causes for construction claims. The outcome is a direct input to subsequent chapters.

2.2 Flood mitigation

Flood can identify as a most destructive natural hazard in both local and global contexts. Floods can occur when the total ingress of water to locality exceed the outflow. United Nations Development programme (UNDP,2004) observe “Floods in Sri Lanka can be classified under different ways, i.e. riverine floods, flash floods, localized floods, reservoir operation floods and reservoir breaching floods. Above all, riverine floods are the most significant causation for flooding in Sri Lanka.”

Yoshitantani, Takemota & Merabtene (2007) observe:

> Sri Lanka is divided into 103 river basins. However, most of the rivers on the island are small drainage basins and only 17 rivers out of the 103 basins that have a basin area of more than 1000km2. Meanwhile, there are 16 rivers whose lengths exceed 100km, among which 12 release 75% of the entire country's average river flow.
>
> Rivers that are particularly vulnerable to floods include Kalu Ganga, Kelani Ganga, Gin Ganga and Nilwala Ganga that flow on the western slope, as well as the Mahaweli Ganga which originates from the central highlands and supplies large amounts of water to the eastern dry zone.

In the recent past the government has shown a lot of interest to initiate projects focused on flood mitigation. Several projects were suggested to implement mitigate flood, from the independence of the country, but none were implemented. Metro Colombo urban development project (MCUDP), initiated in year 2012, funded by World Bank, can be identified as the first thus project successfully to mitigate flood. One of the major objectives of this programme is reduce flooding in the catchment of the Colombo water basin. MCUDP consist of a number of subprojects focused to mitigate flood in Colombo city limits with a total project investment of USD 320 MN. The major projects being implemented under MCUDP are construction of 3 nos. pump houses and 2 nos. underground tunnelling networks in Colombo city limits. While one pump house construction project is reaching toward completion, the tunnelling project has shown nearly 50% financial progress.

World bank has initiated the funding of the second phase flood mitigation projects with an investment of USD 317Mn, Climate Resilience Multiphase Approach Project (CRIP) started on 11 May 2016, less than a week before the tropical cyclone Roanu hit Sri Lanka and caused significant flooding on the Kelani Ganga and other rivers in the country. Unlike, MCUDP which focused on heart of Colombo city limits the CRIP focused on Kelani River far upstream and its tributaries for an approximate length of 15 kilometres between Hanwella and Kaduwela. CRIP is also focusing on identifying optimum locations to build new pump houses to mitigate flood by extensive hydraulic modelling work. Thus, as per this phase of the project on flood mitigation 22 pump houses are scheduled to be constructed in the Kelani River upstream.

The flood mitigation action plan formulated after a hydrological modelling and analysis is based on collected hydrological and meteorological data. Formulated, flood mitigation strategies mainly focus on reducing impact of floods, by building up flood embankments, construction of large reservoirs in upstream of rivers, construction of pump houses with lock gates, introducing riverbank protections etc. The investment on flood mitigation projects are justified by number of economic factors, such as benefits by flood mitigation, expansion of land and property values, against cost

factors such as annual maintenance cost, cost in land acquisition and payment on compensation etc.

2.3 Influence of funding agencies in project initiation

Most of the developing countries depend on international financiers and donors such as the IMF, IFC and the WB to provide finances. As per Mawutor (2010) "Russia, Brazil, China and India have signed over 200 non-recourse finance deals worth over $130 billion in the year 2010 alone".

A study on Malaysian construction industry Jaaffar & Nuruddin (2012) observe:

> Client sector in the construction industry can be classified into two; the public and the private. The public sector client, primarily the government, is observed to be the initiator of major developments on social amenity projects.
>
> Public organisations exist for the ultimate benefit of the citizen, which is the public. Public owners have an obligation to spend the public's money properly and wisely, following a set of rules and regulations.

Yet, as per the guideline set by the WB, project implementation agency is bound to select suitable procurement method as per the guideline set by the bank and need to follow the SBD published by the bank with minimum changes at the stage of implementation. The borrower is responsible for carrying out procurement activities financed by the bank in accordance with these Procurement Regulations. This includes planning, strategizing, seeking and evaluating applications, quotations, bids, proposals, awarding and finally, managing contracts.

Such it is indicate in the set guideline by bank:

> Turnkey contract under which the design and engineering, the supply and installation of equipment, and the construction of a complete facility or works are provided under one contract. Alternatively, the Borrower may remain responsible for the design and engineering and invite bids for a single responsibility contract for the supply and installation of all goods and works

> required for the project component. Design and build, and management contracting are also acceptable where appropriate. (World bank Guidelines, 2004, p 12)

Influence of funding agencies is discussed on chapter 1, introduction. The borrower is bound to follow guidelines set by funding agencies as these projects are implemented from the finance support of these institutions. Such influence of funding agencies and procurement guidelines are also discussed in this chapter. Finally, construction claims are in depth discussed. The outcome will feed to subsequent chapters.

2.4 Various procurement systems used in construction projects

There are number of project delivery systems evolved for years in the industry. Rashid, Taib, Ahmed, Nasid, Ali & Zainordin (2006) describe project procurement as an organized methods or process and procedure for clients to obtain or acquire construction products.

Rasid et al., (2006) further describe:

> Today's highly competitive and uncertain business environment, the client who is the major stakeholder, want speedier delivery of their project with early start of construction work, certainty of performance in term of cost, quality and time, value for money for their investment, minimal exposure to risk and early confirmation of design and price or cost

Project owners can use various procurement system to satisfy their priority of requirement. Thus, time, speed of delivery, cost and quality targets may differ based on procurement method selected. Figure 3 illustrates classification of various procurement systems based on design and construction responsibility.

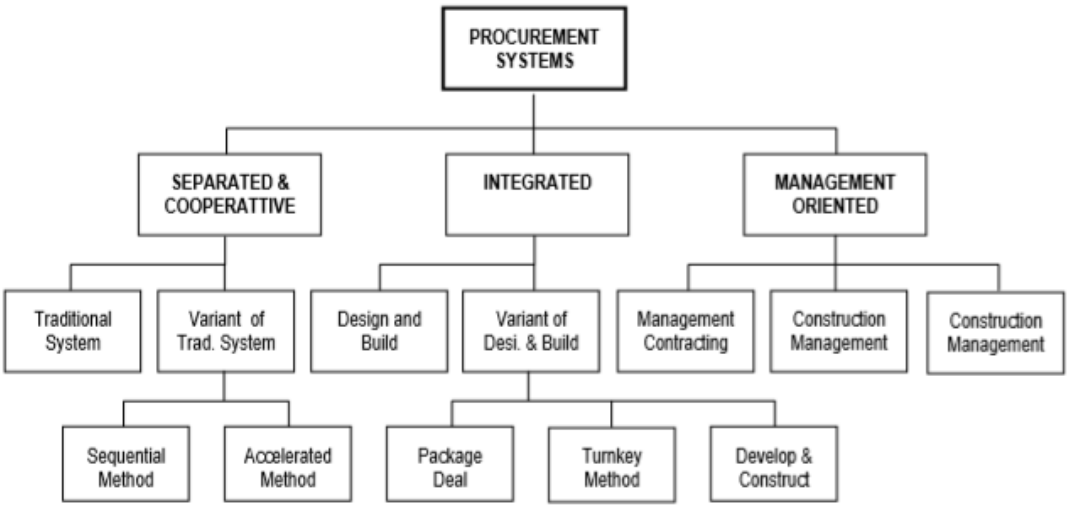

Figure 2.1 : Category of building procurement systems
Rashid et al., (as cited in Masterman, 1996)

Designing and construction activities in separated and cooperative approach procurement system are done by different independent organizations i.e., designers and contractors. In the management approach procurement system, the design and construction of a project is contracted out to a contractor who acts as a management consultant on behalf of the client.

Konchar & Sanvido (1999), compares the project delivery systems exist in world key markets, US and UK. and found:

> Construction management at risk, design-build and design-bid-build are three principal project delivery systems used in the United States today. The UK project delivery systems included traditional design, bid-build, management contracting and several forms of design build.

Klee L. (2013) describes on various construction delivery methods:

> In general, three approaches of construction project organizations can be most frequently encountered. Their names may differ, depending on a particular author and country. They are most frequently called General Contracting or Design-Bid-Build (often abbreviated as D/B/B), Design-Build (often abbreviated as D/B) including EPC (Engineer-Procure-Construct), and Construction Management (often abbreviated as CM), including CM At-Risk and EPCM (Engineer-Procure-Construction Management).

Global construction survey in 2015 done by KPMG reports 30% of respondents say their organization uses the design bid-build approach and 32% favour engineer-procure-construct (EPC). Thus, it is observed these two methods grab the most preferred procurement methods by clients.

Selection of best procurement method for a specific project is a challenge face by stakeholders. Ghadamsi and Braimh (as cited in Ratnasabapathy et al. 2006) identify two major factors i.e., external and internal factors can influence in selecting a procurement method as below:

> External environment factors are such as economics, politics, finance, legal, nature disasters, technology factors and internal environment which can be divided under three main factors project characteristics, client's characteristics and client's requirement. Client requirements can be sub-divided into cost related factors, time related factors and quality related factors. This is illustrated in Figure 4.

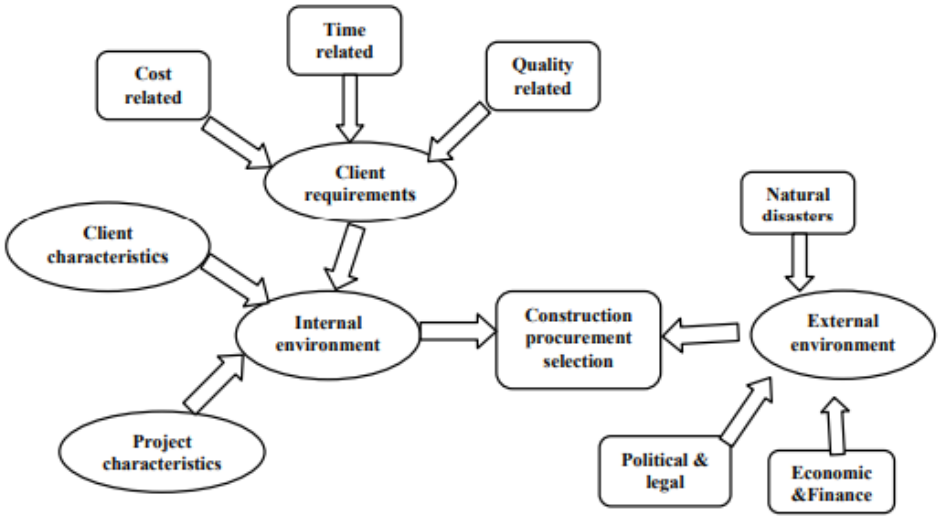

Figure 2.2 : Factors effecting selection of a procurement method,
Source: Ghadamsi and Braimh (as cited in Ratnasabapathy et al. 2006)

Above all, the performance of the selected procurement method is reflected by timely achieving cost, time and quality targets.

2.5 Design and build procurement system

Meantime, Ogunsanmi, Salako & Ajayi (2011) founded client choice toward design and build procurement system in implementing new construction:

> Several clients are now dissatisfied with traditional procurement method because of its slowness and expensive nature. They are now attracted to Design and Build procurement because of its speed of project completion, cost reduction, simplified contracting and creation of single point responsibility.

Interestingly, the flood mitigation projects focused in the current research paper are implemented using design and build procurement as the project delivery system.

Rahid et al., (2006) describe on design and build procurement system:

> Under this system, the client together with his consultants will prepare a tender or bidding document that include the project brief and client's requirements and invite a number of contractors to bid. For the purpose of submitting tenders, the invited contractors will produce their own design, construction and cost proposal

As shown in the Figure 3 various sub classifications of design and build procurement systems are defined. All these have single authority responsibility on both design and construction scopes and linked to lump sum price and a fixed duration contracts.

Seng & Yusof (2006) identify the term Design and Build "refers to the procurement strategy that entails the contractor carrying out the work; the design works as well as the construction and completion of the work". Rashid et al. (2006), describes three subcategories, as illustrated in Figure 3, that are variant to design and build procurement system as package deal, turnkey and develop and construct. Where in package deal the preparation of project brief, sketch and final working drawings, getting all the approval from authorities, project financing, construction, furnishing and commissioning of all equipment and accessories and handing over the project is under client's authority. Turnkey differs by contractors' responsibilities extend up to the handover of the project by giving a meaning to word "turnkey" that, upon completion, the client is given the key and he can then complete the project by "turning the key". In develop and construct method, client's design consultants prepare the concept sketches or designs and passed them to the contractor who will develop them and produced the detailed working drawings. Ogunsanmi, Salako and Ajayi (2011)

observe that build procurement method is one in which a design-build contractor is given the responsibility of carrying out both the design and construction of the project for the client. (p1)

Ogunsanmi et al., (1995) Further state:

> They are now attracted to design and build procurement because of its speed of project completion, cost reductions, simplified contracting and creation of single point responsibility. Furthermore, engineers are intrigued by design and build procurement because it allows them to use their close client relationships to capture larger percentage of construction revenues

Yet, as looking at Figure 3 turnkey contractors are also classified as design and build contract. Thus Seng and Yusof (2006) identify design and build contracts are contracts where the contractor bears the risk of design and build scope and further observe in a true design and build contract no involvement of a consultant but client retains a responsibility during the contract through his employer's representative. This contradict with FIDIC conditions set for design and build contract in Yellow book but literally close to FIDIC silver book. Thus, even turnkey contractors are identified as design and build contracts in literature. Thus, Send & Yusof (2006) observe:

> The prominent feature of Design and Build is to provide a single point responsibility, which means it should be carried out without any mediating consultants and the central contractual position must be between the client and the contractor. This is achieved by allocating all design responsibility and liability to the contractor alone

Panthi (2016) discusses on 10 km tunnelling project related to hydropower construction work under took in Himalayan region, where the main contractor was responsible for both design and construction scope and discuss the risk contractor face due to variant geological conditions and suggest measures to overcome. Despite the observation by Seng & Yusof (2006) on high price certainty, Panthi (2016) observes "geological variations on predicted and actual ground rock mass conditions have led to the considerable deviation on estimated project construction cost and delayed construction completion" in tunnelling projects. Panthi (2016) suggests extra precautions the contractor need to seek to avoid such experience:

> Client did not hold any responsibility for the accuracy or adequacy and the contractor had to bear all costs and expenses caused by any variation and also the contractor was responsible for the costs and delays in completing the project including revenue loss by the client due to delayed start of the electricity production from the plant.
>
> The most important lesion was that the contractor must be careful in accepting and signing the Turn-key contract without verifying the quality of the pre-contract phase engineering geological investigations and data input provided by the client and verification of the real ground condition at site.

Such, it is observed even though design and build procurement was largely appreciated it still faces a considerable risk in the process of implementation. The design and build procurement system evolve continuously in vibrant construction industry seeking better performance. Takim, Esa &Hamid (2013) suggest integrating is a new phase in design and build procurement system:

> The D&B contractor should be capable to tackle the practical aspects of design and construction; build up the design management expertise and project management capability; achieve a high level of cooperation; share common project goals; and develop an ability to resolve conflicts among project team".

Takim (et al.,) observe value management, value engineering, partnering, constructability, benchmarking, total quality management, project management systems, risk management, total quality management, sustainability, information system and safety management can incorporate to avoid poor performance in design and build procurement system. Studying, Malaysian construction industry, Takim (et al.,) suggest sustainability, safety management and total quality management need to incorporate in design and build contracts to improve performance.

2.6 Design and build procurement system set by WB vs FIDIC

By implementing design and build project delivery system responsibility of the design scope can shift toward the contractor. FIDIC yellow book is an interesting choice of project owners to set conditions for the design and build project delivery system. FIDIC identify Yellow book is set for design and build contracts while FIDIC silver book for EPC contracts.

Yet, FIDIC has its own guideline to select FIDIC yellow and silver book, Klee (2013) observe:

> FIDIC Contracts are based on decentralization principle. Red Book and Yellow Book are internationally recognized as conditions of contract with balanced risk allocation. It must be mentioned that Silver Book is based on a problematic risk allocation. These conditions are suitable for project without major unforeseeable risks that are often encountered in private funded projects within Power Plant, Process Plant and Industrial Plant Construction. (p 168)

Frederick Gillion (2012) observe on growing interest usage of FIDIC in Eastern Europe:

> There is undoubtedly a growing trend in the region for significant risks traditionally borne by employers under the FIDIC Yellow Book to be transferred to contractors in public works projects, often by importing provisions or principles from the Silver Book" (P 8)

Studying the design and build contract being implemented by MCUDP, it is understood that the condition of contract in the design and build bid document formulated by world bank is a mix of conditions set both in FIDIC silver and yellow books.

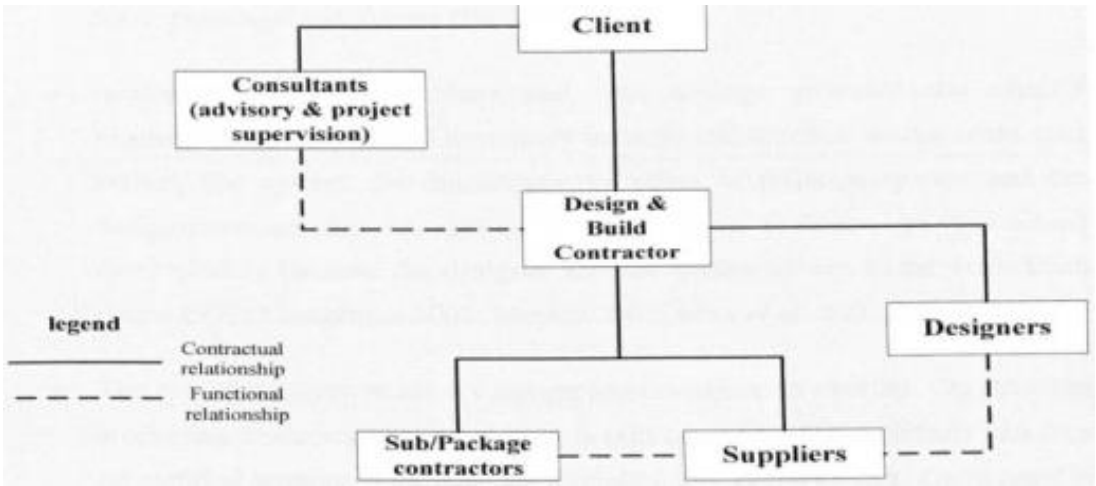

Figure 2.3 : Contractual and functional relationship in design and build contract
(Source: Navi M,Nifa F & Ahmed V (2014)

Further as stated in WB procurement guideline (2007) it is mandatory for the borrower to use documents set by world bank, with minimum changes to address country- and project –specific issues. Further:

> The Borrowers shall use the appropriate standard bidding documents (SBDs) issued by the Bank with minimum changes, acceptable to the Bank, as necessary to address project specific conditions. Any such changes shall be introduced only through bid or contract data sheets, or through special conditions of contract, and not by introducing changes in the standard wording of the Bank's SBDs. p(16)

Studying, Table 1, it is not difficult to understand WB contract conditions set for design and build procurement is mix of conditions set in FIDIC yellow book and FIDIC silver book. It is understood FIDIC balance risk sharing concept is challenged in WB design and build procurement system. Leaving the project owner to add conditions on top of general condition as particular conditions has created more employer friendly clauses.

In FIDIC yellow book engineer's role is to review the drawings submitted by the contractor. This is similar to expected role set to play by the project manager in World Bank funded design and build contract. In FIDIC silver book employer has no responsibility on the accuracy and sufficiency of employer provided data in bidding documents. This is comparatively high risk compared to relevant clause in FIDIC yellow book. Interestingly in World Bank funded projects implemented under MCUDP as per the set conditions under PC, the employer does not take any responsibility for accuracy and correctness of site data provided. Thus, the risk of accurately interpreting and verification of the employer provided site data rest with the contractor as in FIDIC silver book.

Below illustrates the contractor's risk in WB funded design and build contract with conditions set for similar contract by FIDIC, i.e., FIDIC yellow book and EPC contract by FIDIC silver book comparing some each party responsibility related to clauses related design work.

Table 2.1: Comparison of WB funded design and build projects with FIDIC

Sr. No.	Issue	Design related condition		
		FIDIC yellow book	**FIDIC silver book**	**WB book**
1	Contractor's general obligation/ fit for purpose	When completed the works shall fit for the purpose for which they intended, as defined in the employer's requirement (GC clause 4.1)	When completed the works shall fit for the purpose for which they intended, as defined in the employer's requirement (GC clause 4.1)	When completed, the facilities should be fit for the purpose for which they are intended as defined in the contract. (GC clause 9.1)
2	General design obligation/ Design responsibility	The contractor shall carry out, and be responsible for, the design works. Design shall be prepared by qualified, experienced and competent persons (GC clause 5.1)	Any data or information received by the contractor from the employer or otherwise, shall not relieve the contractor from the contractor's responsibility for the execution of work. (GC clause 5.1) The contractor shall deem to have scrutinize, prior to the base date, the employer's requirement. The contractor shall carry out and be responsible for the design works and accuracy of such employer's requirement (GC clause 5.1)	The contractor shall be responsible for any discrepancies, errors, or omissions in the specifications, drawings and other technical documents that it has prepared whether such specifications, drawings and other technical documents have been approved by PM or not (PC clause 20.1.1). The site measurement and other data furnished by the employer and drawings are approximate and provided for the information of contractor to make his own interpretation. The employer does not take any responsibility for its

Sr. No.	Issue	Design related condition		
		FIDIC yellow book	**FIDIC silver book**	**WB book**
				accuracy and correctness of data. The contractor is therefore, advised to carry out his own checks and satisfy himself about adequacy and accuracy of the same before using such data (PC clause 10.1/PC clause 20.1.3)
3	Examination of site data/ unforeseeable physical conditions	If the contractor encounters physical conditions to have been unforeseeable and that will have an adverse effect on the progress and/or increase the cost of execution of the works following procedure shall apply (…i,e notice) (GC clause 4.12)	Contractor deemed to have obtained all necessary information as to risk, contingency and other circumstances. Contractor accepts total responsibility for having foreseen all difficulty and costs. Contract price shall not adjusted to take account of any unforeseeable or unforeseen difficulty or cost (GC clause 4.12)	Contractors has properly inspected boring test results and had visual inspection. The contractor acknowledges that any failure to acquaint itself with all such data and information shall not relieve it's responsibility for estimating difficulty or the cost of successfully performing the facility. (GC clause 9.2)
4	Use of site data/ Employer's responsibility	The contractor shall be responsible for interpreting all data referred to under sub clause 2.5 (GC clausen4.10)	The contractor shall be responsible for verifying and interpreting all data made available by the employer under subclause2.5(site data and items of reference) (GC clause 4.10)	The site measurement and other data furnished by the employer and drawings are approximate and provided for the information of contractor to make his own interpretation.

Sr. No.	Issue	Design related condition		
		FIDIC yellow book	FIDIC silver book	WB book
			Which states "the employer shall have no responsibility for accuracy, sufficiency or completeness of such data and/or items of reference, except as stated in subclause 5.1 (general design obligation) (GC clause 2.5)	The employer does not take any responsibility for its accuracy and correctness of data. The contractor is therefore, advised to carry out his own checks and satisfy himself about adequacy and accuracy of the same before using such data (PC clause 10.1,PC clause 20.1.3)

Gillion (2012) observing this tendency of shifting the risk more toward the contractor in CEE states:

> In a number of CEE states such as Poland and Romania, key risks borne by the contactor under the silver book are now being allocated to the contractor, even in design and build projects where the silver book is not suitable. Those risks include errors in setting out data, inaccurate or incomplete site data, unforeseeable physical conditions and errors in the employer's requirement.

2.7 Claims arising in contract

Hansen (2016) observe "construction claim can be happened when one party to a contract considers that there has been a breach of the other party's obligations" and further states "claims happened due to several events which may affect the construction project's goals, such as delays, disruptions, variation order instructions, defective works, and so on".

Variation is observed as inevitable situation in construction projects. Sunday (as cited in Mohamed, 2001 & Segawa et al., 2002) identify variation orders cannot be avoided

completely and further added that the presence of variation clauses in contracts amounts to admitting that no project can be completed without changes.

Changes results from variations may result to increase cost and time. As states by Hadikusumo & Tobgay (2015) “when one party believes that the other party has not met the contractual obligations or expectations and that they deserve monetary and/or time compensation, they may submit a claim”.

When large complex projects similar to which this research is focused, the aforesaid observation is much valid.

Al-Qershi & Kishore (As cited in Levin, 1998) observe “claims are the result of the rising complexity of the projects, the price structure of construction industry and the legal approach taken by a lot of owners and contractors”.

Hadikusumo & Tobgay (2015) focusing complexity of documents set in hydropower projects conclude:

> Hydropower projects are extremely complex and consist of several interrelated activities/work packages of different disciplines involving numerous parties. Moreover, construction contracts are extremely long, complex sets of documents, which are not well understood by the parties and lead to different interpretations by different parties.

According to Tochaiwat & Chovichien (as cited in Bu-Bshait & Manzanera, 1990) observe typical construction claims against owners are caused by a lot of reasons such as poor project planning, scope changes, constructive variation orders, errors and omissions, contract accelerations and expediting

Tochaiwat & Chovichien (2006) classify contract claims under 3 distinct categories:

1. Objectives of claims:
    - claim for extra time to complete the contract,
    - claim for extra money arising out of the contract

2. Legal basis:

- Contractual claims: Contractual claims are the claims that fall within the specific clauses of the contract, typically ground conditions, valuation, variations, late issue of information, and delay in inspecting finished work.
- Extra-contractual claims: This type of claim has no specific grounds within contract but is a result of breach of contract, which may be express or implied. An example of extra-contractual claim is the extra work incurred as a result of defective material supplied by the employer.
- Ex-gratia claims: Ex-gratia claims are the claims that there is no ground existing in the contract or the law, but the contractor believes that he has moral grounds, e.g. additional cost

3. Claims that facilitate the calculation of damages

- Delay claim
- Scope-of-work claim
- Acceleration claim
- Changing-site condition claim

As stated in below diagram conflicts can lead toward claims. Such claims if not resolved lead toward disputes.

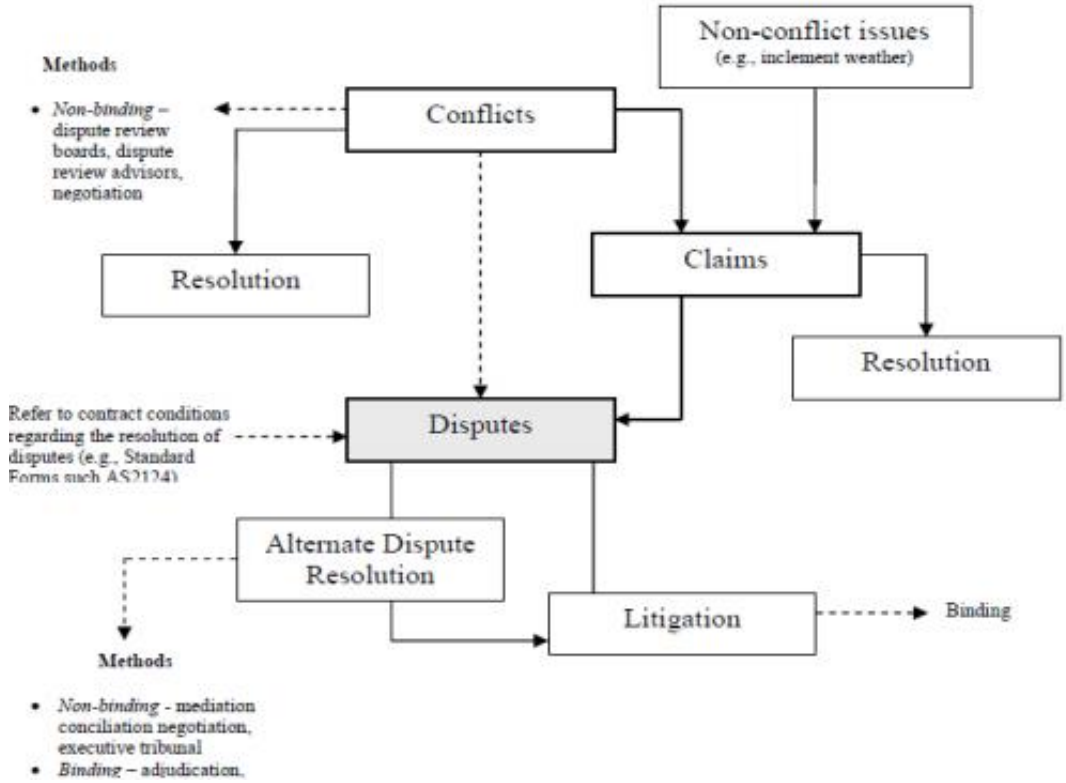

Figure 2.4: Interrelationship of conflicts, claims and disputes
Source: Sinha & Wayal (as extracted from Kumaraswamy, 1997)

As shown in figure 3, disputes can be avoided by resolving claims early. Further claims are raised after notifying a request for compensation by the effected party. When such submitted claims are not accepted disputes may arise. As stated by Soderland (2018) "Key objective of the claim management process is to resolve certain problems in an effective and efficient way in order to avoid any further disputes".

2.8 Sources for construction claims and categorization

Khekale & Futane (2015) identify there are number of ways to classify construction claims. Classification may be by related parties, rights claimed, legal basis and characteristics of claims. On legal basis construction claims can be divided into three categories, namely contractual, extra-contractual, ex-gratia and extension of time claims. Khekale & Futane (2015) identified eleven sources of claims. AL-Qershi & Kishore (2017) identified 39 causes of claims and grouped all these causes under six

categories, namely owner representative related, contractor related, contract document related, project related, contractual relationship related and external factors.

Similarly, Shen, Tang, Yu, Duffield, Hui, Wei & Fang (2017) have analysed causes of contractor's claim in international EPC hydropower projects and grouped claims and problems in construction industry under three major factors, namely external risks, client organizational behaviour, and product definition and justified their finding by observing issues raised in six projects. Interestingly, designer and supplier related factors were excluded by them. Justifying this exception, Shen (as cited in Pishdad, Bozorgi & Garza, 2012) and state that "from perspective of EPC contractors, claim resulting from designer and supplier related factors could not be raised against client since designer, the supplier and the constructor are working as one team".

Hadikusumo & Tobgay (2015) observing thirty five claims arises in large scale hydropower projects in Bhutan identified two major claim types as change claims, impact claims. Change claims occurred due to formal/directed changes due to client, constructive changes on site, design related changes, changes due to differing/adverse site conditions and changes due to act of god (ex: floods, bad weather). Impact claims are result of loss of productivity of workers, machinery and equipment left idle due to delay/disruption beyond the control of the contractor.

As observed in figure 6 claims can end up as disputes. Such E. Cakmak & P. I. Cakmak (2014) identified factors that lead toward disputes in a contract as owner related, contractor related, design related, contract related, human behaviour related, project related and external factors, while further subdividing major factors to sub factors to identify the importance.

Analysing various causes for variations, Sunday (2010) categorized factors related to claims as design consultant related changes, owner related changes, contractor related changes and other changes and further categorized major factors by introducing sub factors.

Khekale and Futane (2015) managed to identify interrelationship of claims with delay and states “A survey done in western Canada found that the large majority of claims involved some delay and in many cases delay exceeded the original contract duration by over 100%.”. Chan & Kumaraswamy (1997) managed to group causes for delays in contract as poor site management and supervision, unforeseen ground conditions, low speed of decision making involving all project teams, client-initiated variations and necessary variations of works. Similarly, Memon, Rahman and Hasan (2014) observe the direct links of variation orders to project delay and thus leading to claims.

Such, different authors group causes for claims and problems under different topics. Similarly, in previous researches variation orders, project delays, dispute interrelate to factors that causes claims.

2.9 Categorization sources for claims in the research

Major causes for claims identified by several authors were discussed in detail in the previous chapter. Similarly, it could observe there is no consistency when causes for claims are grouped under different headings. Further to the aforesaid observation, causes for claims were grouped under six major headings, namely contract document related, design and drawing related, related to changes of submitted bid, owner & consultant related, contractor related and other. These are presented in Table 2.2

Table 2.2: Causes for construction claims identified by previous authors

Causes for construction claims	Khekale cand Futane (2013)	Al-Quers	Shen et sl., (2017)	Memon et al., (2014)	Sunday (2010)
1.0 CONTRACT DOCUMENT RELATED					
Defects and loopholes in contract document	√				
Different type of contract document use		√			
Client's conceptual design drawings are insufficient (unclear scope of work)		√	√		
Conflict in contract document				√	√
Change in scope/ Inadequate scope				√	√
Discrepancy between contract document		√			
Poor written contract and ambiguities		√			
Variation between actual and original quantities		√			
Differing site conditions against the contract document	√				√
2.0 DESIGN & DRAWINGS RELATED					
Hold of work due to drawing release delay/ Approval delay	√	√	√		
Change in design				√	
Design complexity				√	
Design error or omissions (discrepancy)		√			√
Inadequate design details				√	
Inadequate working drawing details				√	√

Causes for construction claims	Khekale cand Futane (2013)	Al-Quers	Shen et sl., (2017)	Memon et al., (2014)	Sunday (2010)
3.0 RELATED TO CHANGES TO THE OFFERED BID					
Change in specifications by consultant/client				√	√
Change in government regulations					√
Change of initial scope ex: locations switch stations/additional roads/protective layers of piping		√	√		
Change in project schedule				√	√
Owner's interest to get work done at a faster pace					
The scope of work substantially modified	√				√
Unexpected change in material price /labour		√	√		
Complex execution		√			
4.0 OWNER AND CONSULTANT RELATED					
Lack of support to get custom clearance			√		
Lack of coordination					
Delay in handing over site		√			
Delay in payment release/Financial issues	√		√	√	
Lack of knowledge in available material & equipment					√
Inadequate project objective					√
Delay in approval of complete work		√			
Long line of authority in organization		√			
Adverse economic condition of client			√		√

Causes for construction claims	Khekale cand Futane (2013)	Al-Quers	Shen et sl., (2017)	Memon et al., (2014)	Sunday (2010)
Delay in supply of power & water	√				√
Lack of judgement and experience					
Lack of staff contractor's project management		√			
Change in specifications by the consultant				√	
Slow decisions by owner/consultant		√		√	√
Excessive claims by owner		√			
Awarding bid to lowest bidder		√			
Desire to get work done in faster phase	√				
Over/ Under measure completed work					
Owner's personality/Obstinate nature		√		√	
Acceleration stop and go on		√			
5.0 CONTRACTOR RELATED					
Delay caused by contractor causing loss of profit to owner	√	√			
Lack of communication					√
Poor planning and management done by contractor/ Experience		√		√	
Labour price escalation			√		
Lengthy and late procurement activities					
Poor workman ship/execution errors		√		√	√
Shortage of skilled manpower/ equipment/ subcontractor	√	√		√	√

Causes for construction claims	Khekale cand Futane (2013)	Al-Quers	Shen et sl., (2017)	Memon et al., (2014)	Sunday (2010)
Contractor's financial difficulties				√	√
Contractor's desired profitability					√
Failure to deal promptly with changes		√			√
Poor procurement process				√	
Liquidity damages	√				
6.0 RELATED TO OTHER					
Contractor's delay due to incremental weather	√		√		
Disputes between client/local communities or international political issues			√		
Change in government regulations			√		√
Strikes			√		

It was observed 59 causes for claims were identified by 5 researchers. It can observe 22 causes were observed at least in two research studies. This shows causes for claims identified by each assignment differs to previous study. It can observe these studies are done on various geographical areas, and are implemented under different procurement systems etc. The identification of various causes done by various researchers is important as output can directly be fed to subsequent chapters.

2.10 Chapter summary

Literature review in this chapter is greatly helpful in developing the next chapter. The finding in table 2.2 is a direct input for identifying causes for claims in upcoming chapters. The table 2.1 shows the way contract conditions are deviated in WB design and build procurement system from conditions set by FIDIC. As it is discussed claims are raised due to breach of other party's obligation. The claims raised in this project reflect the intensity of deviation from initial expectations. Next chapter identify various claims from the identified causes for claims applicable to current design and build contract.

3.0 RESEARCH METHODOLOGY

3.1 Introduction

The chapter on research methodology illustrates the systematic approach used in solving the research problem. The previous chapter established a theoretical background on the research. In this chapter research process, research approach, data collection and analysis technique are illustrated in detail.

3.2 Research process

The aim of the research is to identify causes for claims in design and build projects focused on flood mitigation which are being implemented with the support of funding agencies. It is expected to identify potential causes for claims by the questionnaire survey and suggest measures to minimize such causes in similar projects mostly when the project is under client's control, i.e at pre-contract stage. To elaborate causes for claims and propose solutions it is needed to follow an appropriate research process. The methodology adopted in achieving this objective is illustrated bellow in the Figure 3.1.

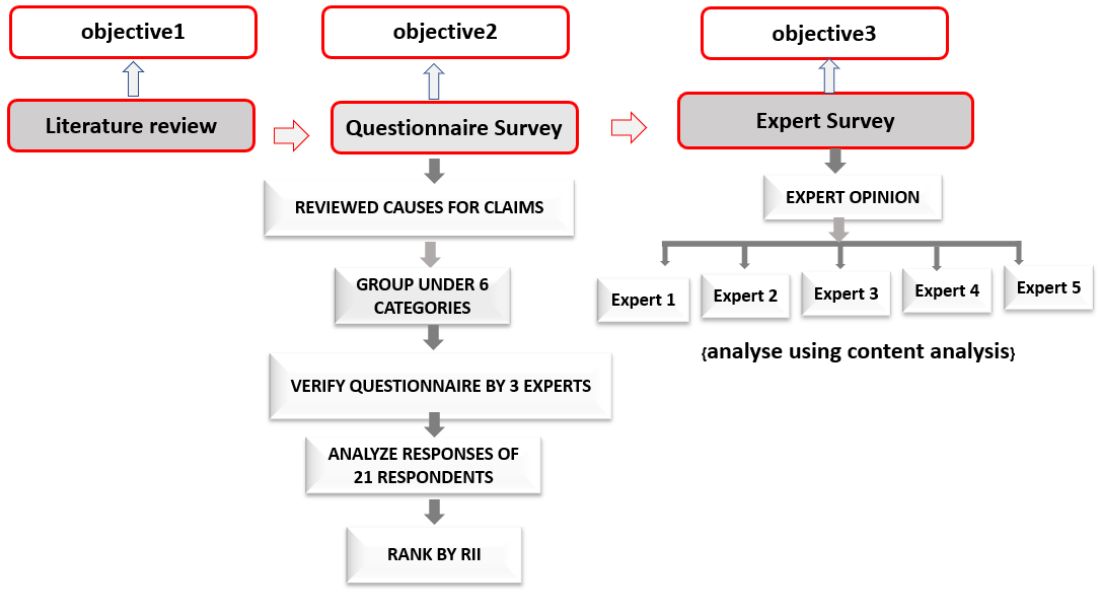

Figure 3.1: The research process illustration

The methodology illustrated in the figure 3.1, was built up to achieve three major objectives focused in the Chapter one.

3.3 Research Approach

As illustrated in the Figure 3.1 the literature review, was used to achieve the first objective, i.e., to identify causes for construction claims. The causes for claims identified from literature review were grouped under six headings, and named as major causes for claims. The expert verification was used to filter most relevant causes from the causes identified from the literature review.

Identified relevant causes for claims were used to build up the questionnaire shown in the Appendix 1. The responses received to the questionnaire survey was ranked using RII. Thus, most relevant causes for potential claims at the pre-contract stage were identified. This is the second objective of the research.

The expert opinion survey was followed at the final stage to achieve the third objective, i.e., to propose measures to minimize/avoid claims in future design and build flood mitigation construction projects in Sri Lanka.

Hussein observe (as cited in Jick, 1979) in triangulated approach, triangulation is defined as the use of multiple methods mainly qualitative and quantitative methods in studying the same phenomenon, can use for the purpose of increasing study credibility. Further express such approach identify by some researchers as Methodological triangulation.

Fellow & Liu (2008) Describe the outcome of qualitative and quantitative research as:

> Generally, quantitative approaches provide ‘snapshots’ and so, are used to address questions such as what, how much, how many? Thus, the data, and results, are instantaneous or cross-sectional. Qualitative approaches seek to find out why things happen as they do.

Acet Inc. (2008) identify combination of these two approaches as mixed method approach and further illustrate the challenge of a mixed method approach is to ensure that the two data collection methods complement but do not duplicate each other such avoid additional cost and waste of time.

In the first stage, questionnaire survey shown in appendix 1 was used to prioritizing causes of claims. quantitative data and numerical methodology were used for this purpose. In stage 2, questionnaire shown in Appendix 2 was used to collect qualitative data to propose measures to minimize claims.

3.4 Research Strategy

Johnson & Chrisetension (2014) observe three major streams of research approaches namely qualitative method, quantitative method and mixed method approach and observe quantitative research generally reduces measurement to numbers. In survey research attitudes are usually measured by using rating scales. Further states, On the other hand, qualitative researchers do not usually collect data in the form of numbers. Rather, they conduct observations and in-depth interviews, and the data are usually in the form of words. In mixed research, the researcher uses a mixture or combination of quantitative and qualitative methods, approaches, or concepts in a single research study or in a set of related studies. Figure 3.2 illustrates various approaches researchers can use in each major stream of research.

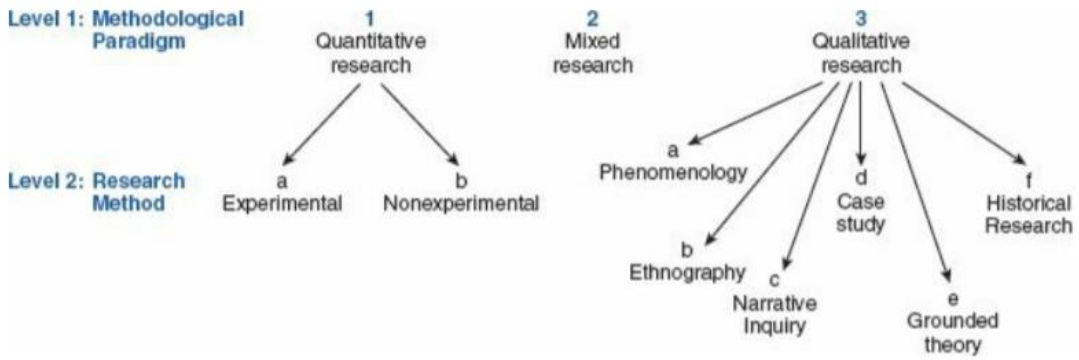

Figure 3.2: Types of research
Source: Johnson & Chrisetension (2014)

3.5 Research Techniques

Research techniques can be discussed under two main sub headings as data collection techniques and data analysis techniques.

3.5.1 Data collection techniques

Three types of interviews were conducted in the research work to collect data. Namely preliminary interviews, questionnaire survey and expert interviews.

Preliminary interviews

The literature review exercise done in the chapter 2 could use to identify 59 causes for claims. These findings are an important entry point to build up the balance research work. As discussed in summary chapter 5 these findings were from various studies on different geographical areas and different procurement systems. Thus, the aim of the preliminary interview was to identify most relevant factors to the current research work. Identified causes for claims were listed and presented to 3 experts to select most relevant causes to the current research work, i.e. at pre-contract stage of design and build procurements.

Questionnaire survey

Questionnaire survey was used to collect data at first stage. Thirty-nine causes for claims identified following the preliminary interviews was used for this purpose. The questionnaire was distributed, and respondents were requested to identify relevancy of each cause for a claim. Respondents can respond two extreme ends of agreements by marking “never” to “almost always” as two extreme ends. Marking choices in a Lickert scale from “one” to “five” the respondents can mark relevancy of each question to a claim at the pre-contract stage. Thus, the respondent can mark “one” in the Likert scale if he believes it has no impact for generating a potential claim. Similarly, in opposite the respondent can mark “five” in the Likert scale if he believes very high impact for a potential claim. The questionnaire was distributed among 21 selected respondents. Considering the need of high contractual knowledge and enough exposure to respond the questionnaire the researcher obliged to follow the purposive sampling technique.

Thus, questionnaire was given to 21 identified respondents. All who receive the questionnaire have responded.

Expert interview

In the third stage an expert opinion survey was conducted. Thus experts were requested to respond with solutions to overcome claims. Such, open ended interviews were used as data collection technique. As identified Zhang (as cited in Easterby-smith et. al,1991) fundamental of all qualitative method is "in-depth interview'. There are three types of interviews, namely unstructured, semi -structures and structured. Here, unstructured interview technique was used. Thus, five experts holding senior positions such as contract managers, project managers, senior quantity surveyors are to be responded. Zhang (2008) illustrate the validity of opinions of senior position holders as:

> One motive for interviewing corporate elites was based on the assumptions that senior executives would provide the best view of the issue under study. Compared with junior colleagues, it was felt that senior executives were more extensive and reliable source of information.

3.4.2 Data analyses technique

Both quantitative and qualitative data analysis techniques were used to analyze the finding. Quantitative data analysis technique was used for analyze responses of the questionnaire survey and quantitative techniques was used to analyze responses of the expert interviews.

Analysis of quantitative data

In quantitative data analysis, Chan and Kumaraswamy (1997) observe the mean and standard deviation of each individual factor is not suitable to assess the overall rankings because they do not reflect any relationship between them. Hence, they propose to transform numerical scores of each of the identified factor to relative importance indices to determine the relative ranking of each individual factor.

Thus, to analyze the outcome of the questionnaire in stage 1, RII (relative important index) was used. Microsoft excel was used for the calculation purpose due to ease, accuracy and time saving. To identify the RII of each of six major causes the averaging technique of all supportive causes was used. Relative important index of individual cause was derived by

RII=∑(W*n) x 100%／A*N

where W = weighting given to each factor by the respondents and ranges from 1 to 5 where '1' is 'not significant' and '5' is 'extremely significant',

A = highest weight (i.e. 5 in this case)

N = total number of respondents.

n=frequency of responses

Further RII of each group was calculated by averaging relative index value of each supportive factors in the group, i.e., Using averaging technique. such

RII'=∑RII／N

∑RII = Addition of all supportive factors in relevant group

N = total number of supportive factors in the group

Analysis of qualitative data

In the second stage, expert opinion survey, was adopted to propose suggestions to minimize claims. The content analysis method was used in stage 2 as the technique of analysing expert opinion. Fellows & Liu (2008) identify "the content analysis method as most simplistic, to determine the main facets of a set of data, by simply counting the number of times an activity occurs, a topic is mentioned". Further illustrate, it is important to have a sound theoretical basis to assist development and testing of hypotheses – such as non-verbal behaviours of people in meetings

3.5 Summary

The approached research processes were illustrated in this chapter. It was illustrated the reason for adopting a mix method approach, a combination of qualitative and quantitative analysis technique, for this research.

Questionnaire surveys were carried out to collect data in stage 1 and RII was used to analyse the outcome.

Expert opinion on reducing claims were analysed using content analysis technique.

4.0 DATA ANALYSIS, FINDINGS AND DISCUSSION

4.1 Introduction

This chapter will focus on outcome of three types of interview undertook in this research namely preliminary interview, questionnaire survey and expert interviews. Preliminary interviews were used to identify most relevant major and supportive causes for claims. Questionnaire survey was used to rank the above identified major and supportive causes for claims. Finally, expert interviews were undertaking to suggest measures to overcome claims.

4.2 Preliminary interview and findings

The identified 59 causes were reduced 39 after the conducting the preliminary interview. As per expert opinion The identified 39 causes for claims are tabulated in the table 4.1. As per the opinion of 3 experts balance 20 causes were identified as not relevant to initiate claims at the pre-contract stage of design and build projects focused in the research.

Table 4.1: Major causes and Supportive causes for claims

Sr. No.	Causes relevant to claims in design & build procurement
1	**contract document related factors**
1.1	Client's conceptual design drawings
1.2	Conflict in contract document
1.3	Poorly written contract and ambiguities
1.4	Variation between actual and original quantities
1.5	Differing site conditions against to the contract document
1.6	Unforeseen ground conditions
1.7	Defects and loopholes in contract document

Sr. No.	Causes relevant to claims in design & build procurement
2	**Design & Drawing related factors**
2.1	Change in design
2.2	Design complexity
2.3	Inadequate design details
2.4	Inadequate working drawing details
2.5	Design drawing error/ omissions (discrepancy) submitted for approval
2.6	Hold of work due to drawing release Approval delay
3	**Factors related to changes of the bid submitted by the contractor**
3.1	Change in scope of the project ex: locations switch stations/ additional roads
3.2	Change in technical specifications by consultant/client
3.3	Change in project schedule
3.4	Cient's interest to get work done at a faster pace
3.5	The scope of work substantially modified
3.6	Unexpected change in material price /labor
3.7	Change in government regulation
4	**Client and consultant related factors**
4.1	Lack of support to get custom clearance
4.2	Delay in payment release
4.3	Adverse economic condition of client
4.4	Change in specifications by the consultant
4.5	Slow decisions by Client
4.6	Excessive change orders by Client
4.7	Award bid to lowest bidder
4.8	Delay in handing over site

Sr. No.	Causes relevant to claims in design & build procurement
5	**Contractor related factors**
5.1	Delay caused by contractor causing loss of profit to the Client
5.2	Poor planning and management
5.3	Lengthy and late procurement
5.4	Poor workmanship
5.5	Shortage of skilled manpower
5.7	Contractor's financial difficulty
6	**Other factors**
6.1	Contractor's delay due to incremental weather
6.2	Disputes between client/local communities
6.3	Change in government regulations
6.4	Strikes

4.3 Questionnaire survey and finding

The questionnaire survey was carried out to prioritize most critical causes from above listed 39 supportive causes and 6 major causes. The questionnaire survey shown in the appendix 1 was formed from above listed 39 supportive cause for a claim which are grouped under 6 major causes. The objective of this questionnaire survey was to identify and prioritize factors relevant to a potential claim when the project is under client's control, i.e. at the pre-contract stage. The outcome of the questionnaire survey will be analyzed under two subheadings, i.e., under six major factors and under all 39 supportive factors.

Identification of targeted respondents using a sampling technique

Ellow & Liu (2008) suggest correct respondents need to address to obtain a desired and accurate outcome in a research. Further, describe "Selection of providers is also

likely to be critical, although the statistical principles of (large) sampling endeavour to overcome such criticality by ensuring that the sample is a good representation of the population". Thus, it is important to identify a correct set of target audience having knowledge of the current research work. The identified respondents need to understand the complexity and the meaning of the terms used in this questionnaire which are more focused on contractual terms. Thus, the researcher happened to identify potential candidates who can satisfy above need. Further the respondents need to have enough exposure to the project. Such purposive sapling technique was used to identify respondents. Johnson & Chrotenson (2014) identify the purposive sampling technique as a method the researcher specifies the characteristics of the population of interest and locates individuals with those characteristics.

Targeted respondents for the questionnaire survey

The identified respondents for the questionnaire are managers, engineers or quantity surveyors involve in construction of 2 projects focused on flood mitigation under MCUDP. Both these projects are funded by World Bank. The respondents employed either under client, contractor, or consultant party. All have involved over one year in the project span thus having good exposure to the project.

Table 4.2: Detail of the respondents involved in the questionnaire survey

Designation of the individual			**Total Number**
Manager	**QS**	**Engineer**	
3	6	12	21

4.3.1 Analysis supportive causes for claims by questionnaire survey

The RII value of each claim was calculated and inserted against each supportive factor. Please refer to table 4.3.

Table 4.3: Ranking supportive causes for construction claims

Sr No	Major sources	Supportive causes for originating claims at pre-contract stage	RII	Ranking
1	Contract document Issues	Unforeseen ground conditions	0.85	1
		Differing site conditions against contract document	0.83	2
		Client's conceptual design drawing	0.78	3
		Conflict in contract document		
		Poorly written contract document and ambiguities	0.75	4
		Variation between actual and original quantities	0.73	5
		Defects and loopholes in contract document	0.68	6
			0.65	7
2	Client and consultant related issues	Slow decisions by client	0.78	1
		Change in specification by consultant	0.70	2
		Delay in payment release		
		Excessive claims by client	0.70	3
		Award bid to lowest bidder	0.68	4
		Delay in handing oversite	0.68	5
		Lack of support to get custom clearances	0.58	6
		Adverse economic conditions of client	0.50	7
			0.48	8
3	Change of bid submitted by the contractor	Change in technical specifications by client/consultant	0.78	1
		Change in project schedule	0.73	2
		Unexpected change in material/ labour price	0.70	3
		The scope of work substantially modified	0.68	4
		Change in scope of project ex: locations switch stations/roads	0.65	5
		Client's interest to get work done at faster pace	0.60	6
		Change in government regulations	0.55	7

Sr No	Major sources	Supportive causes for originating claims at pre-contract stage	RII	Ranking
4	Design and drawing	Change in design	0.83	1
		Hold of work due to drawing release approval delay	0.63	2
		Design complexity	0.58	3
		Inadequate design detail	0.58	4
		Design drawing errors/omissions submitted for approval	0.58	5
		In adequate working drawing details	0.50	6
5	Contractor related	Shortage of skilled manpower	0.65	1
		Poor workmanship	0.63	2
		Poor planning and management	0.63	3
		Delay caused by contractor causing loss and profit to client	0.60	4
		Lengthy and late procurement	0.53	5
		Contractor's financial difficulty	0.50	6
6	Other	Delay due to incremental weather	0.83	1
		Disputes between client/ local community	0.60	2
		Change in government regulations	0.60	3
		Strikes	0.53	4

Observing each supportive cause for claim it can observe two unforeseen conditions, i.e unforeseen ground conditions and differing site conditions ranked top in contract document related claims. Interestingly, as shown in table3, item 3 in literature review the contractor need to bear the risk of unforeseen site conditions.

The respondents observe overall highest-ranking factors resulting to a claim are unforeseen ground conditions, differing site conditions, design changes and delays due to incremental weathers situations. Similarly change in technical specifications and errors in client's conceptual design drawings are also ranked top. Observing value of each individual ranking it can observe a number of factors were identified by respondents as situations that could have minimized if client has put more interest in the pre-contract stage.

4.3.2 Analysis major causes for claims by questionnaire survey

The table 4.3 present the RII value calculated on responses given by 21 respondents. As it is shown in the table 4.1 all 39 causes for claims can be grouped under 6 major causes. The averaging technique was used to identify RII value of each major cause. This value is presented in the table 4.4 below.

Table 4.4: Ranking major sources for construction claims

Sr. no.	Major Sources for construction claims	RII	Rank
1	Factors related to contract document	5.25	1
2	Factors related to design and drawing	3.68	4
3	Changes of the bid submitted by the contractor	4.68	3
4	Client and Consultant related factors	5.08	2
5	Contractor related factors	3.53	5
6	Other	2.55	6

From these RII values shown in the table 4.4 three major causes for construction can be identified as bellow.

- Factors related to contract document- RANK 1
- Client and Consultant related factors-RANK 2
- Changes of the bid submitted by the contractor-RANK 3

The other three major causes which were considered less important as per the responses given by respondents are illustrated as bellow.

- Factors related to design and drawing-RANK 4
- Contractor related factors-RANK 5
- Other-RANK 6

Observation in table 4.4 is important to the client. This shows that the major potential cause for claims are relate to contract document. Claims could have minimized putting more attention on these factors at the pre-contract stage of the project.

4.4 Expert interview and findings

An extensive open-ended discussion was carried out with respondents from both consultant and contractor who hold senior positions such as contract managers, project managers, quantity surveyors and engineers. Respondents came up with their opinions and suggestions to avoid claims based on their experience and exposure to the project.

4.4.1 Claims raised due deficiency of submitted bid

Consultant's quantity surveyor of tunnel project highlighted claims that relates to BOQ. As per the discussion it is understood that these issues could have avoided at the pre-contract stage. As per the QS, the contractor is now in the mid of a struggle with consultant for approve cost of foreign labour involved in utility diversion. As per the consultant the basis for justification is hindered as the high cost on foreign labour rate cannot justified.

"It was not mandatory to contractor to provide a breakdown of the BOQ items in the current lump sum contract. The current situation arised as the contractor could not get approved the new rate for foreign labour from the client/ consultant as they have not included the day rate for foreign labour in the BOQ. The rates used cannot compared with hourly labour rate in the local market. Thus, there is no basis to justify contractor's cost in utility diversion which had used foreign labour".

Table 4.5: Contributing factors related to claim-deficiency of submitted bid

Sr. No.	Causes for claim
1	variation between actual and original quantity
2	defects and loopholes in contract document
3	contractor's financial difficulty
4	unexpected change in material, labour rates

Proposed solutions by the consultant's quantity surveyor

- Contractor need to seriously look at BOQ in the bid submission.
- The client could have included a BOQ to cover major elements and a supplementary BOQ which could use for calculation any variation to the contract. This could have included to include foreign labour hourly rate.

4.4.2 Claims raised due client drawing errors

Contractor's contract manager commented that the current claim on pump-house power distribution substation could have avoided if the client has foreseen this situation.

"At the project pre-contract stage, it was decided to get power from a location in right bank of the canal. Ceylon Electricity Board (CEB) has now informed that they have no access to the defined location in right blank. The location was identified as in the Lanka Electricity Company (LECO) boundary and CEB is not willing to provide power via LECO. Finally, the substation location was shifted to a new location in the left bank of the canal which comes in CEB boundary. Finally, the contractor came up with a claim for the additional cost incurred due to location shifting which include cost of additional building construction work, cots of additional length of power cables etc."

Table 4.6: Contributing factors related to claim - client drawing issues

Sr. No.	Causes for claim
1	Client's conceptual drawing
2	Defects and loopholes in contract document
3	Poor planning and management
4	Change in design
5	Change in scope of the project Ex: locations of switch stations, additional roads

Proposed Solutions by the contractor's contract manager

- Client with all stake holder parties must sit, study and guarantee the possibility to provide utility service to agreed location. This should be done before finalizing conceptual drawings.
- Client need active involvement to support the contractor when deal with government agencies.

4.4.3 Claims raised due ambiguity in contract document

The contractor is expecting to raise a claim to cover the cost of an additional generator. As per the contractor the client could have avoided this ambiguity at the project pre-contract stage if the client has promptly acted when they have voiced this ambiguity at the pre bid meeting. Consultant's project manager explained the background for the claim as below.

"The contract document states 50% power requirement should be given by generators. The client has not specifically mentioned the required number of pumps to run is 3 numbers but instead wrongly understood that 50% power is enough to run 3 pumps. But in actual scenario, due to high start current, 3 pumps cannot run from 50% generator power".

Table 4.7: Contributing factors related to claim - ambiguity in contract document

Sr. No.	Causes for claim
1	Conflict in contract document
2	Change in technical specification of submitted bid
3	Change in specification by consultant
4	Scope of work substantially modified

Proposed solutions by the consultant's project manager

- Pre bid meeting and pre-award meetings must effectively use to resolve ambiguities in contract at the project pre-contract stage by client

- ❖ Avoid ambiguous terms in contract document. Be precise and accurate in information in the contract document.

4.4.4 Claims raised due to stakeholder agency involvement

Clint's senior engineer highlights lack of support and lack of understanding of various government agencies is leading toward possible time extension claim. The situation was explained by the client's senior engineer.

"Irrigation department does not allow the contractor to widen the existing flood bund without introducing new lock gate system to the canal. As per irrigation department flood bund widening can be allowed only after completion of the lock gates. Unfortunately, the lock gate repair is now in the critical path in the agreed construction plan. This paved path to a time extension claim. This issue could have identified early if these were known by all parties at the pre-contract stage. Contractor could have get agreed to a different project implementation plan at beginning if parties were exposed to this situation early"

Table 4.8: Contributing factors related to claim - errors in agreed programme

Sr. No.	Sources for claim
1	Differing site conditions against contract document
2	In adequate working drawing details
3	Change in project schedule
4	Poor planning and management

Proposed solutions by client's senior engineer

- ❖ Consultant must be vigilant enough to identify items in critical path
- ❖ The client should have identified these issues at project pre-contract stage.
- ❖ Special care must take when items need permission of various government institutions for implementation.
- ❖ All project stake holders must see the big picture to complete a project on time.

4.4.5 Claims raised due lack of site data

As per the general condition's set in the bidding document, the contractor is responsible to verify the site condition before bidding. Yet, the client has provided few bore hole data to the bidder while strictly instructing to the contractor to bear the responsibility of accuracy and sufficiency of provided data. As per the tunnel contractor's QS, client failed to provide access to site and collect additional bore hall test data.

"In the bidding document of the tunnel contract the client has provided 8 bore hole data to identify subsurface condition. contractor wanted to access to certain location to get more bore hall data before submitting the bid, but due to time restrictions this was missed. Now, after awarding the contract, the contractor collected 16 bore hole data. As per the new data the soil condition is far different to contractor's expectations"

Table 4.9: Contributing factors related to claim - lack of site data

Sr. No.	Sources for claim
1	Differing site conditions against contract document
2	Unforeseen ground conditions
3	Change in project schedule
4	Poor planning and management

Proposed solutions by contractor's quantity surveyor

- The client should have provided enough time to the contractor to collect data related to unforeseen ground condition
- Client should have provided BOQ in the bidding document so contractor can fill rates for rock and soil excavation
- Client should have clarified the contractor need to take full risk of unforeseen ground condition.

4.5 Summary

The research focused on claims arises in two design and build contracts. From the questionnaire survey it was observed that major causes for claims is related to failures in contract document. This factor is supported by 6 supportive factors related to this major factor. Similarly, by analyzing expert interviews it was understood several opportunities to avoid claims were missed at project pre-contract stage. Claims end up with additional cost and time to client. When donor funded projects are considered it is a difficult task to agree for additional cost from donor agencies. Thus, the client needs to make every effort to minimize claimable situations at the project pre-contract stage.

The lessons learnt will immensely help toward timely delivery of new projects and avoid claimable situations in future projects.

5.0 CONCLUSIONS & RECOMMENDATIONS

5.1 Introduction

As it was discussed in length, Sri Lanka faces the challenge in seeking methods to mitigate, urban flooding which is a result of adverse weather conditions and highly unplanned urbanization. Government need external agency support to implement projects of this nature which need high initial investment., thus the support of external funding organizations ex: world bank, is a need of time. Research focuses on first flood mitigation project is being implemented in Sri Lanka. Meantime, more similar projects are to be implemented in years to come under the CRIP. Such the finding of this research is a great asset to get an awareness on client's role for successful implementation of future projects while minimizing potential claims. Conclusions, recommendations and suggestions in this chapter may be important as a lesson learnt exercise. Thus, the current study will be an asset to minimize claims at the pre-contract stage of future such projects to be funded by various external funding agencies.

5.2 Conclusions

Project owner need to identify the potential causes for claims and means to minimize such situations while implementing design and build projects, focused on flood mitigation. The research aimed on identifying and minimizing potential claims at pre-contract stage of the design and build flood mitigation projects. As it was discussed no previous studies were done on this topic. This subtopic discusses the extend the the set objectives under the chapter 1 were achieved in this research.

<u>Reviewing causes for construction claims</u>

Reviewing causes for construction claims is the first objective set in the research. The literature review has put high weightage to study potential causes for claims identified by previous research studies. Accordingly, 59 causes for claims identified in five previous research studies were identified and listed. All these supportive causes for claims were grouped under six major causes for claims. These are contract document related factors, client-consultant related factors, issues due to changes in submitted bid,

design and drawing related factors, contractor related factors and some factors which could be categorized as other. As the next step, an effort was made to analyze these factors focused on applicability and priority to this research.

Identifying most relevant causes of claims applicable to design and build flood mitigation projects in Sri Lanka

The 59 causes for claims observed by literature review could narrow down to 39 causes based on experts' comments. These 39 causes can identify as potential causes for claims in implantation of the design and build projects focused on flood mitigation in Sri Lanka. Thus, in contract management aspects now client get opportunity to focus 39 factors that can identify potential causes for claims. These 39 causes are still listed under six major causes for claims. First 3 major causes for claims out of six major causes ranked by RII method can listed as document related factors, client-contract related factors and changes in the submitted bid. Thus, the client can put more effort on above three major factors to reduce potential claims. In addition, identified 39 supportive causes for claims also could ranked using RII method. This gives the observer to identify highest contributing supportive factors for claims. unforeseen ground conditions, design changes. delays due to incremental weathers situations in tops the list of these 39 supportive causes for claims.

Proposing measures to minimize/avoid claims in future design and build flood mitigation construction projects in Sri Lanka

Expert interview paved the path open to collect expert opinions to minimize claims. The open-ended discussion exposed number of suggestions to minimize potential claims. These are highlighted in the subtopic 5.3, recommendations of this chapter. Experts suggested number of benefits that client could have achieved by introducing BOQ to the bidding document, getting involve utility service providers in inception, need of increasing accuracy of technical inputs in the bidding document, effectively using pre-bid and pre-award meeting and reviewing the limit client can transfer unknown risk. Paying more interest on these suggestions client may be able to reduce claims arising in future such projects.

5.3 Recommendations

It is observed that the major cause for claims in researched projects is the contract document related factors. Thus, client organization should pay special attention when the project document is compiling at the initial stage. Client need to seek all opportunities to minimize possible claims by implementing below proposed suggestions in order to minimize claims at the pre-contract stage of the project.

5.3.1 Introducing a BOQ to bidding document

BOQ format was not available in bidding document of both projects. Such bidder was supposed to submit own BOQ in their submission. If a supplementary BOQ could have included to the bidding document by the client, with ex: man hours, plant hours etc. to be submitted by the bidder, parties will find it is easy to justify cost in changes in the scope by presenting man, machine allocation.

5.3.2 Involvement of utility service providers

When implementing projects in city limits it is an inevitable to deal with government agencies such CEB, CMC, Irrigation department etc. Client should identify and foresee possible interferences from these organizations at pre-contract stage and need to get involve such agencies from inception, i.e., from the stage of preparing bidding document.

5.3.3 Technically precise bidding document

The bidding document must avoid ambiguous terms ex: 50% of electricity load etc. Ambiguous technical information leaves opportunities to raise claims to an opportunistic bidder. Such gaps should be closed at pre-contract stage. Technical experts need to deploy to revisit employer’s engineering requirements in the bidding document.

5.3.4 Effectively use pre-bid and pre award meeting

The client must identify Pre-bid and pre-award meetings as an opportunity to avoid ambiguities of the bidding document. Meetings with bidders at pre-contract stage should use effectively to avoid situations leading toward claims. Conclusion and agreements made in such meetings should make binding document to the contractor's submitted bid before signing the contract. Specially client must identify whether contractor was aware about certain risks transferred to the bidder ex: unforeseen ground conditions etc.

5.3.5 Identify the extend a client can transfer the risk

As it was discussed in literature review, the bidding document set by world bank for design and build procurements is a mix condition of FIDIC yellow and FIDIC silver book. Thus, the contractor's risk has exceeded compared with traditional design and build document, i,e. yellow book. Both contractor and client must understand the extend the risk can be shared between parties in the contract document. ex: unforeseen ground conditions etc. Such, knowing the risk, client should give access to site and ample time to verify unforeseen ground conditions to the bidder.

5.4 Limitation of the research

The study focused on identifying claims that could have avoided effectively by managing the pre-contract stage of a design and build procurement funded by external agency. The focused research topic relates to design and build contract set under the WB procurement guidelines. The urban flooding, which the research focused, is comparatively new subject for discussion. Interestingly, as discussed initially the research focused on first such project primarily focused on flood mitigation in Sri Lanka.

As discussed, these projects are implemented by foreign contractors with poor knowledge in English. If not for the language barrier, more opportunities exist to reach toward more respondents. Further, the questionnaire survey, was responded by all

parties, i.e., contractor, client and consultant. The questionnaire survey focused on causes for claims, should have separately focused on contractor, consultant and client. Such opinion of each party in reducing claims could have identified. But, unfortunately, this was restricted due to non-availability of enough respondents, at this stage.

5.5 Future research directions

The claims in a complex project is believed to be unavoidable as per the discussion in literature review. The current research focus is limited to pre-contract stage of design and builds contracts focused on mitigation of urban flooding.

The opinions to reduce change claims were ranked based on opinions given by all parties involved, i.e., contractor, consultant and client. Opinions given by different parties, ex contractor team, client team, contractor team could have compared separately. This will give an opportunity to rank individual party on suggestions in reducing claims

The current research focus is narrowed down to pre-contract stage. This could have expanded to other phases., i.e., construction stage. Such could have capture more different set of claims and opportunities in reducing claims, ex: interest claims due to delayed payment by the client, which were not identified in this research.

Further, future research can focus on other types of contracts ex: design bid and build contracts which are implemented in Colombo city limits under Asian Development Bank (ADB) funds ex: Sewerage and drainage pipe replacement projects. Opinions on such projects is worth to incorporate and compare with design and build contract focused in the current research work.

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Questionnaire 1

Please indicate how frequently the following factors resulted in construction claims in design and build flood mitigation projects, you are employed. Please indicate never if not related. {Claims may be able to minimize if following factors were considered at Pre-contract stage}

Sr. no.	Sources for construction Claims	Level of Impact				
		NEVER	SELDOM	SOMETIMES	OFTEN	ALMOST
		1	**2**	**3**	**4**	**5**
1	***contract document***					
1.1	Client's conceptual design drawings					
1.2	Conflict in contract document					
1.3	Poorly written contract and ambiguities					
1.4	Variation between actual and original quantities					
1.5	Differing site conditions against to the contract document					
1.6	Unforeseen ground conditions					
1.7	Defects and loopholes in contract document					
2	***Design & Drawing***					
2.1	Change in design					
2.2	Design complexity					
2.3	Inadequate design details					
2.4	Inadequate working drawing details					
2.5	Design drawing error/ omissions (discrepancy) submitted for approval					

Sr. no.	Sources for construction Claims	Level of Impact				
		NEVER	SELDOM	SOMETIMES	OFTEN	ALMOST
		1	**2**	**3**	**4**	**5**
2.6	Hold of work due to drawing release Approval delay					
3	**C*hanges of the bid submitted by the contractor***					
3.1	Change in scope of the project ex: locations switch stations/ additional roads					
3.2	Change in technical specifications by consultant/client					
3.3	Change in project schedule					
3.4	Cient's interest to get work done at a faster pace					
3.5	The scope of work substantially modified					
3.6	Unexpected change in material price /labor					
3.7	Change in government regulation					
4	***Client and consultant related***					
4.1	Lack of support to get custom clearance					
4.2	Delay in payment release					
4.3	Adverse economic condition of client					
4.4	Change in specifications by the consultant					
4.5	Slow decisions by Client					
4.6	Excessive change orders by Client					
4.7	Award bid to lowest bidder					
4.8	Delay in handing over site					

Sr. no.	Sources for construction Claims	Level of Impact				
		NEVER	SELDOM	SOMETIMES	OFTEN	ALMOST
		1	**2**	**3**	**4**	**5**
5	***Contractor related***					
5.1	Delay caused by contractor causing loss of profit to the Client					
5.2	Poor planning and management					
5.3	Lengthy and late procurement					
5.4	Poor workmanship					
5.5	Shortage of skilled manpower					
5.7	Contractor's financial difficulty					
6	***Other***					
6.1	Contractor's delay due to incremental weather					
6.2	Disputes between client/ local communities					
6.3	Change in government regulations					
6.4	Strikes					

Questionnaire 2

Claims arises due to number of reasons. It was identified major causes as contract document related, design and drawing related, changes of the contractor's bid submitted, issues related to client/consultant, contractor related and other issues.

- Please identify how these claims arises in this contract

- Please suggest ways and means this could have avoided as per your experience